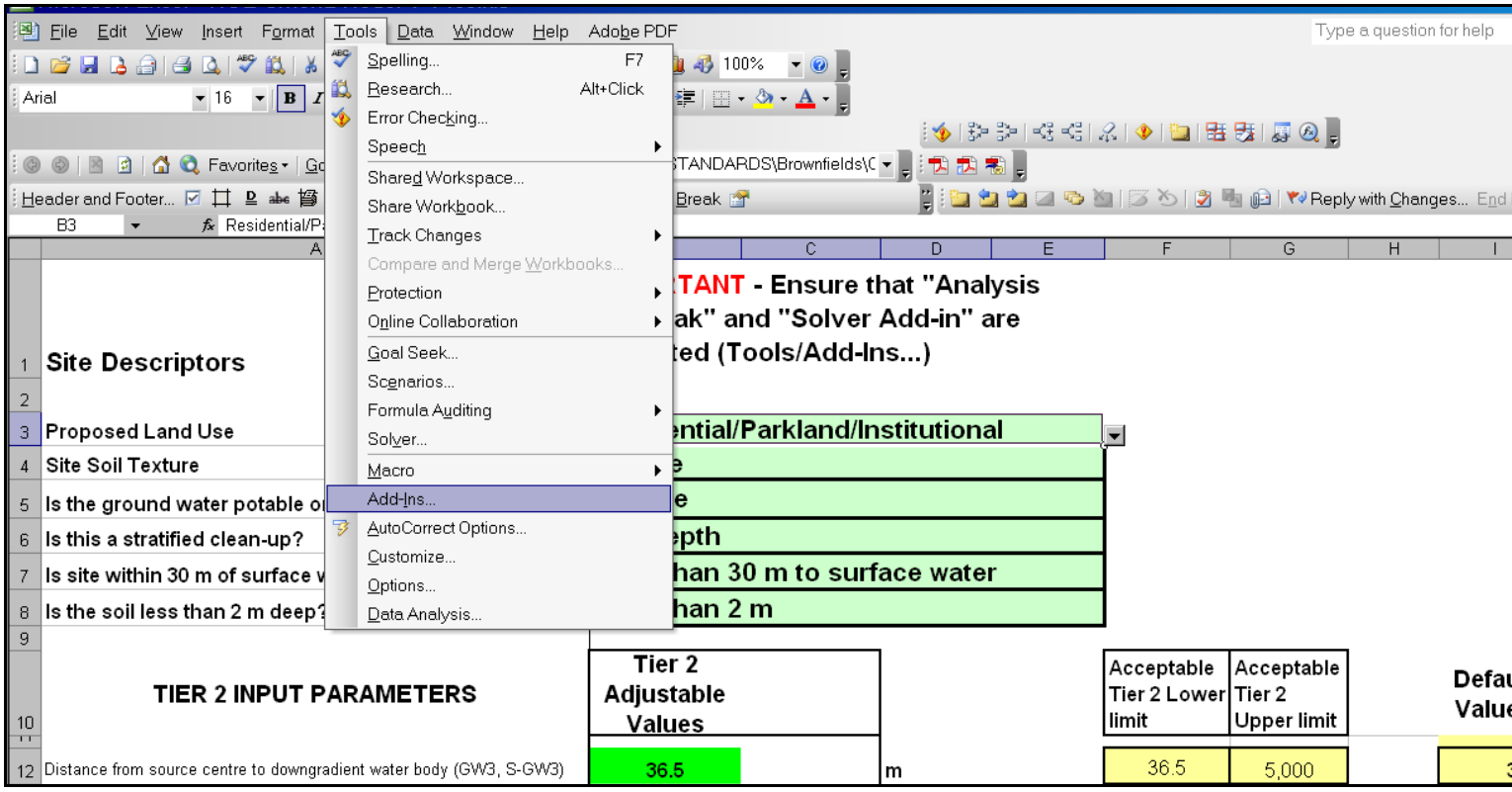
A Guide to Using the Modified Generic Risk Assessment (Tier 2) Spreadsheet Model

The following is a suggested step-by-step guide for using the Tier 2 (Modified Generic) Risk Assessment spreadsheet. This model will be available in the interim period until the more robust web-based Tier 2 system is fully operational. Although the spreadsheet is relatively user friendly, there are some aspects for which guidance may be of considerable assistance for the user in generating appropriate site condition standards. In the following procedure, it is assumed that the QP has already conducted a complete Phase Two Environmental Site Assessment (ESA) in accordance with the requirements of Ontario Regulation 153/04, and has followed all ESA recommendations included in **Appendices 1** and **2** of this document.

Downloading and Setting up the Model

1. The "MOE Tier 2 Model" can be downloaded from the following website. The model is designed to work on Microsoft Excel 2003 (or later). MOE can not assure that results from its use on other programs will be the same as produced by Excel.
   http://www.ene.gov.on.ca/envision/land/decomm/condition.htm
   An Open Office Calc version that has been checked for errors may also be made available; however, formatting of this version is in scientific notation such that rounding can be to two digits.

2. Be sure that "Analysis Tool Pak" and "Solver Add -in" are installed in Excel
   - go to Tools – Add-Ins, then check the appropriate boxes, and click OK

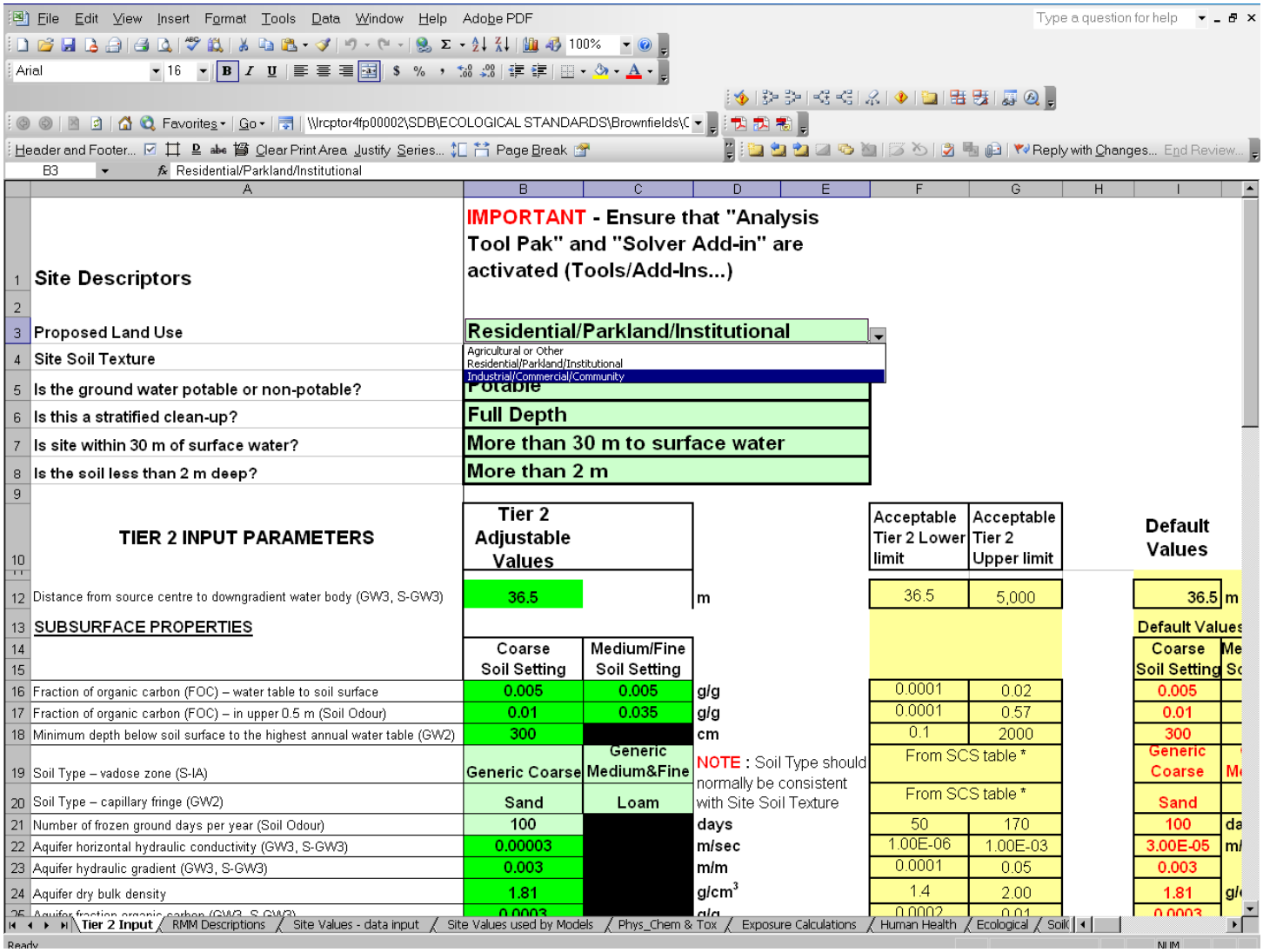


Running the Model

1. Open “MOE Tier 2 Model” and click on the “Tier 2 Input “ tab

The cells that are highlighted in either of the two green shades are cells where the user can input information. The bright green shaded cells are for direct numeric user input, and the lighter (or duller) green shaded cells have pull down menus that pop up when the arrow on the right side of the box is clicked.

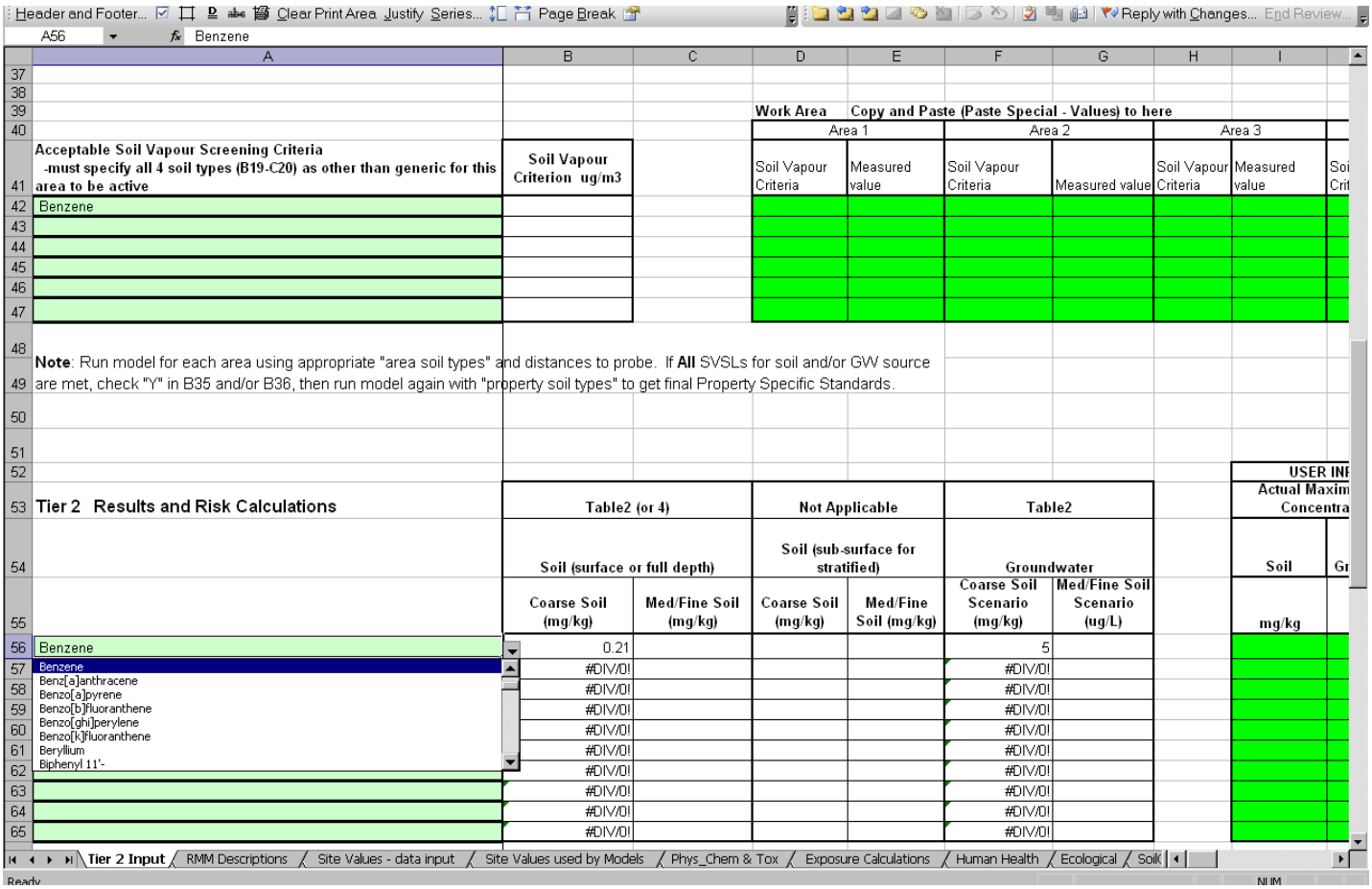
Check Site Descriptors in cells B3-B8 to be sure that the descriptions match the site in question. To change a description, click on the appropriate cell, then click on the down arrow on the right end of the box and choose the description that is appropriate for the site. Explanations of these site descriptors are available in the document “Records of Site Condition: A Guide on Site Assessment, the Cleanup of Brownfield Sites and the Filing of Records of Site Condition“, which can be found at http://www.ene.gov.on.ca/envision/gp/4728e.pdf


IMPORTANT - Ensure that "Analysis Tool Pak" and "Solver Add-in" are activated (Tools/Add-Ins...)
Site Descriptors
Proposed Land Use
Residential/Parkland/Institutional
Site Soil Texture
Is the ground water potable or non-potable?
Is this a stratified clean-up?
Full Depth
Is site within 30 m of surface water?
More than 30 m to surface water
Is the soil less than 2 m deep?
More than 2 m
Agricultural or Other
Residential/Parkland/Institutional
Industrial/Commercial/Community
TIER 2 INPUT PARAMETERS
Tier 2 Adjustable Values
Acceptable Tier 2 Lower limit
Acceptable Tier 2 Upper limit
Default Values
Distance from source centre to downgradient water body (GW3, S-GW3)
36.5
m
SUBSURFACE PROPERTIES
Coarse Soil Setting
Medium/Fine Soil Setting
Fraction of organic carbon (FOC) – water table to soil surface
Fraction of organic carbon (FOC) – in upper 0.5 m (Soil Odour)
Minimum depth below soil surface to the highest annual water table (GW2)
Soil Type – vadose zone (S-IA)
Generic Coarse
Generic Medium&Fine
Soil Type – capillary fringe (GW2)
Sand
Loam
Number of frozen ground days per year (Soil Odour)
Aquifer horizontal hydraulic conductivity (GW3, S-GW3)
Aquifer hydraulic gradient (GW3, S-GW3)
Aquifer dry bulk density
NOTE : Soil Type should normally be consistent with Site Soil Texture
From SCS table *
Tier 2 Input
RMM Descriptions
Site Values - data input
Site Values used by Models
Phys_Chem & Tox
Exposure Calculations
Human Health
Ecological

2. Once all the site descriptors match those appropriate for the site, start entering the relevant site data in cells B12 – B26. If the data entered is outside of the acceptable range (cells in yellow, F12-G26) a warning will pop up. The Tier 1 default values are given in cells I12 to J26 (also in yellow highlight), and once a value changes from the default, it is displayed in *italics*. For sites where the overall soil texture is fine-medium, be sure to enter the appropriate data in Cells C16 and C17. You may leave the default values for the soil texture not used. Note that cells B19-C20 and B21 are changed using the pull down menus to choose the appropriate soil type or frozen days. For determination of the **Soil Type**, use the measured sand, silt and clay contents from the site in conjunction with the information in **Appendix 3** of this document. At this stage, be sure to enter the appropriate value for the "**Property Soil Type**", as opposed to "**Area Soil Type**". For determination of which value to use for **Frozen Ground Days**, use the maps included in **Appendix 4** of this document. When using Appendix 4, if it is uncertain as to in which of two zones your site falls, use the highest of the two numerical values.

   Note that none of the four cells (B19-C20) for Soil Type can include either of the terms "Generic Coarse" or "Generic Medium/Fine" if you want the soil vapour screening levels (SVSLs) to be calculated. These two Soil Types are not options for Tier 2 when soil vapour screening levels are desired. There should be a reasonable correspondence between the Soil Types and the Site Soil Texture, or the QP should have a full understanding and explanation as to the reasons why they do not correspond reasonably well. In order to expedite the review timeline, the ministry recommends that any modification made to any model assumptions be made in accordance with the objective for the assumption category set out in the table found in **Appendix 1** of this document, and reported in accordance with the recommendations in **Appendix 2** of this document.

3. After all the available tier 2 properties have been input, you may wish to take a look at the results that the spreadsheet has generated and compare them with the maxima measured on the site. To do this, click on Cell A 56 and then click on the down arrow at the right end of the cell and choose a chemical identified as a Contaminant of Concern (CoC) at the site. Repeat in cells A57-A65 for all CoCs on site. (Note - This spreadsheet allows for 10 CoCs, but if you have more than 10 contaminants on the site, you can run the model again for the remainder of the CoCs). The initial soil and groundwater criteria generated by the spreadsheet will appear in cells B56-G65.



	A	B	C	D	E	F	G	H	I
37									
38									
39				Work Area	Copy and Paste (Paste Special - Values) to here				
40				Area 1		Area 2		Area 3	
41	**Acceptable Soil Vapour Screening Criteria -must specify all 4 soil types (B19-C20) as other than generic for this area to be active**	**Soil Vapour Criterion ug/m3**		Soil Vapour Criteria	Measured value	Soil Vapour Criteria	Measured value	Soil Vapour Criteria	Measured value
42	Benzene								
43									
44									
45									
46									
47									
48									
49	**Note**: Run model for each area using appropriate "area soil types" and distances to probe. If **All** SVSLs for soil and/or GW source are met, check "Y" in B35 and/or B36, then run model again with "property soil types" to get final Property Specific Standards.								
50									
51									
52									USER INF
53	**Tier 2 Results and Risk Calculations**	**Table2 (or 4)**		**Not Applicable**		**Table2**			Actual Maxim Concentra
54		**Soil (surface or full depth)**		**Soil (sub-surface for stratified)**		**Groundwater**			**Soil**
55		**Coarse Soil (mg/kg)**	**Med/Fine Soil (mg/kg)**	**Coarse Soil (mg/kg)**	**Med/Fine Soil (mg/kg)**	**Coarse Soil Scenario (mg/kg)**	**Med/Fine Soil Scenario (ug/L)**		**mg/kg**
56	Benzene	0.21				5			
57	Benzene	#DIV/0!				#DIV/0!			
58	Benz[a]anthracene	#DIV/0!				#DIV/0!			
59	Benzo[a]pyrene	#DIV/0!				#DIV/0!			
60	Benzo[b]fluoranthene	#DIV/0!				#DIV/0!			
61	Benzo[ghi]perylene	#DIV/0!				#DIV/0!			
62	Benzo[k]fluoranthene	#DIV/0!				#DIV/0!			
63	Beryllium	#DIV/0!				#DIV/0!			
64	Biphenyl 11'-	#DIV/0!				#DIV/0!			
65		#DIV/0!				#DIV/0!			

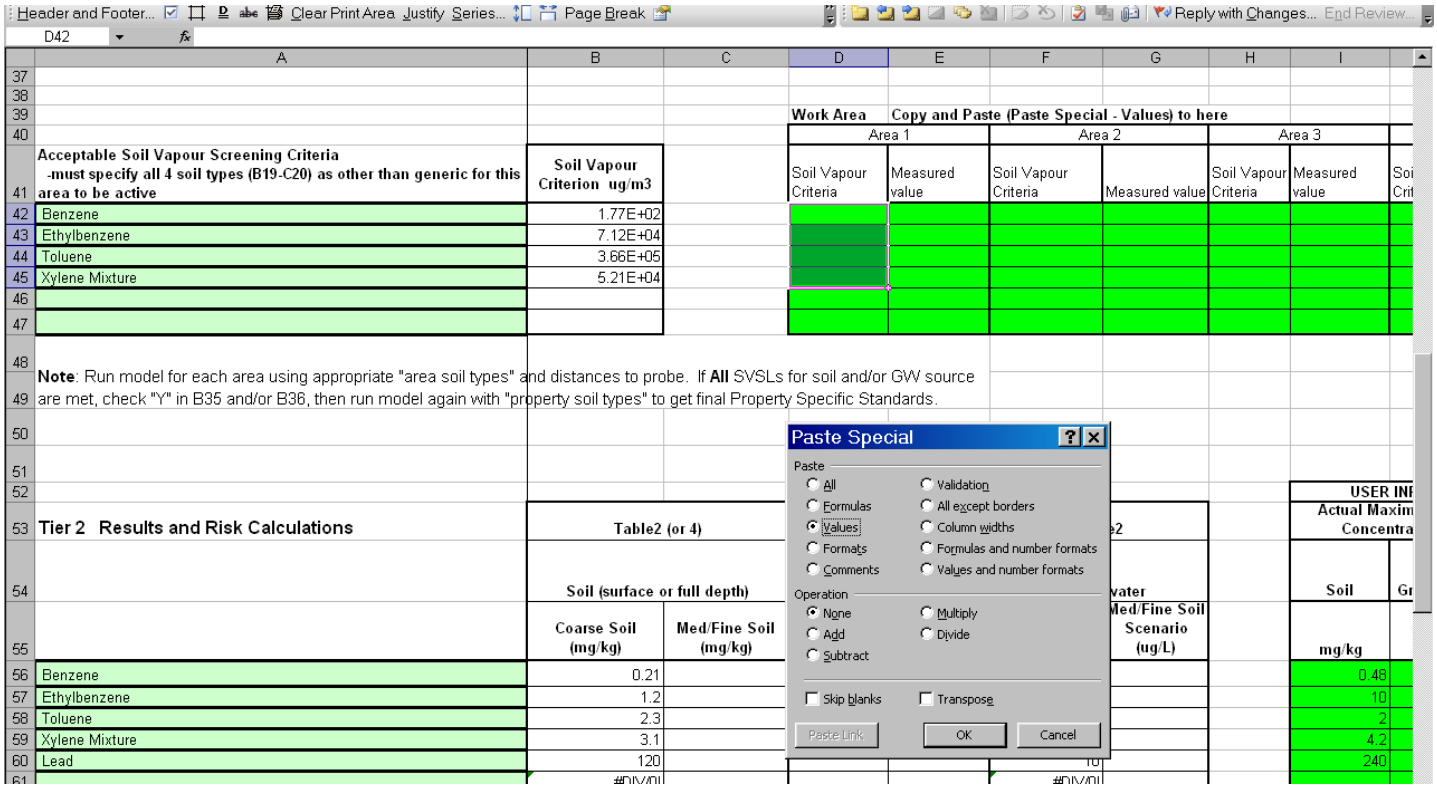
Tier 2 Input | RMM Descriptions | Site Values - data input | Site Values used by Models | Phys_Chem & Tox | Exposure Calculations | Human Health | Ecological | Soil(

4. Your actual (measured) site concentrations for soil and groundwater can be added to the spreadsheet in cells I56-J65, and your calculated reasonable estimate of the site maximum can be input into Cells K56-L65. Note that the estimate of the site max cannot exceed 1.2 times the actual measured site max (a warning will pop up if it does). If for all CoCs none of the measured concentrations (I56-J65) exceed the respective values calculated by the spreadsheet (B56-G65), then your site meets the appropriate Tier 2 **"Property Specific Standards"** (PSSs), and you may submit the risk assessment to the Ministry for approval. **The PSSs that you can use for RSC purposes are displayed in Cells B72-D81**

5. If any of the measured concentrations (I56-J65) of volatile chemicals exceed the respective values calculated by the spreadsheet (B56-G65), and if you have conducted soil vapour measurements, then you can calculate soil vapour screening levels and compare them to your actual soil vapour measurements, make sure that you fulfilled all the requirements in Appendix 1. Begin by entering the names of the volatile chemicals for which soil vapour measurements are available into cells A42-A47, and entering the depth to soil vapour measurement (B26) and the corresponding area soil type – vadose zone (B19 or C19) for one of the soil vapour sampling locations on the site where soil vapour measurements were made. The soil vapour screening levels, appropriate for the soil vapour sampling location at a given depth to soil vapour measurement and to the site inputs currently in the spreadsheet, will then appear in cells B42-B47 (that is, if the Area Soil Type cells (B19-C20) do not contain either of the two generic Soil

Types). These soil vapour criteria are specific to the particular soil vapour sampling location and depth from which the soil vapour samples were taken, and which is represented by the current Tier 2 input data that you have entered in the spreadsheet. Be sure to separate areas that are groundwater source areas from those that are soil source areas such that you can choose the appropriate measures in cells B35 or B36 later. Repeat this process as many times as needed. You need to develop soil vapour screening levels for each sampling location and depth to soil vapour measurement (as specified in Appendix 1) in which soil vapour measurements were taken at the RA property.

6. Therefore, after checking to be sure that the input parameters (especially soil type and depth to soil vapour measurement (B26)) are correct for that specific soil vapour sampling location, copy the soil vapour screening level criteria (Cells B42-B47) to Cells D42 to D47. (highlight cells to be copied, right click, choose copy, move pointer to D42, right click, choose "**Paste Special**", then "**Values**"(this last part is **critical,** otherwise you will get formulae rather than numbers, or you may alter the formatting!).



7. Now type in the maximum soil vapour measurement recorded for that specific soil vapour sampling location and depth to measurement for the appropriate chemical in cells E42-E47. If a maximum measured concentration exceeds the soil vapour screening level, it will be highlighted in red.

8. Revise the Soil Type – Vadose Zone and the Depth to Soil Vapour Measurement to be in accordance with the identified characteristics for the next soil vapour sampling

location and depth where soil vapour samples were taken and repeat steps 7 & 8 putting the results in the section of the spreadsheet for "Area 2". Then repeat for other sampling locations. (This spreadsheet allows for up to 4 sampling locations at a time)

9. If, for a given CoC, all soil vapour measurements at all the required sampling locations and depths meet the appropriate calculated soil vapour screening levels, then you may change the value in cells B35 and/or B36 (soil vapour screening levels are met), as appropriate for the source of the soil vapours, to a "Y" (on the pull down menu). This effectively allows for the removal of the S-IA and the GW2 pathways from the Tier 2 PSSs. You will have to keep track as to which CoCs meet the soil vapour screening levels, and be sure to use the results from checking "Y" in B35 or B36 only for those CoCs that meet the soil vapour screening levels. One can then uncheck the "Y" to derive the PSS for those CoC's which do NOT meet the soil vapour screening level. Before determining your PSSs, you must now go back and re-enter the "Property-wide Soil Types". If at this point all your maximum measured concentrations at the site meet the calculated criteria in cells B56-G65, then your site meets the appropriate Tier 2 PSSs, and you may submit the risk assessment to the Ministry for approval. **The "Property Specific Standards" that you can use for RSC purposes are displayed in Cells B72-D81.**

10. If your site still doesn't meet the Tier 2 standards, then you may wish to take a look at the Tables of Drivers (see screen shot below) to determine which component is limiting the PSS value. To do this, at the bottom of the spreadsheet find the appropriate "Table of Drivers" tab (soil or water), click on it, and then find the appropriate Table of Standards, Soil Texture, and Land Use (Soils only) in rows 1 and 2. Scroll down to the CoC of interest, and determine which component is highlighted. The highlighted cell indicates the driving component (note that if this component is below the reporting limit or the background concentration they are also highlighted, and the criterion is bumped up to the higher value). You may wish to note both the driving component and the next lowest component value (the second driver) and compare both with your CoC concentration. Short descriptions of all the components are given at the end of Appendix 5.

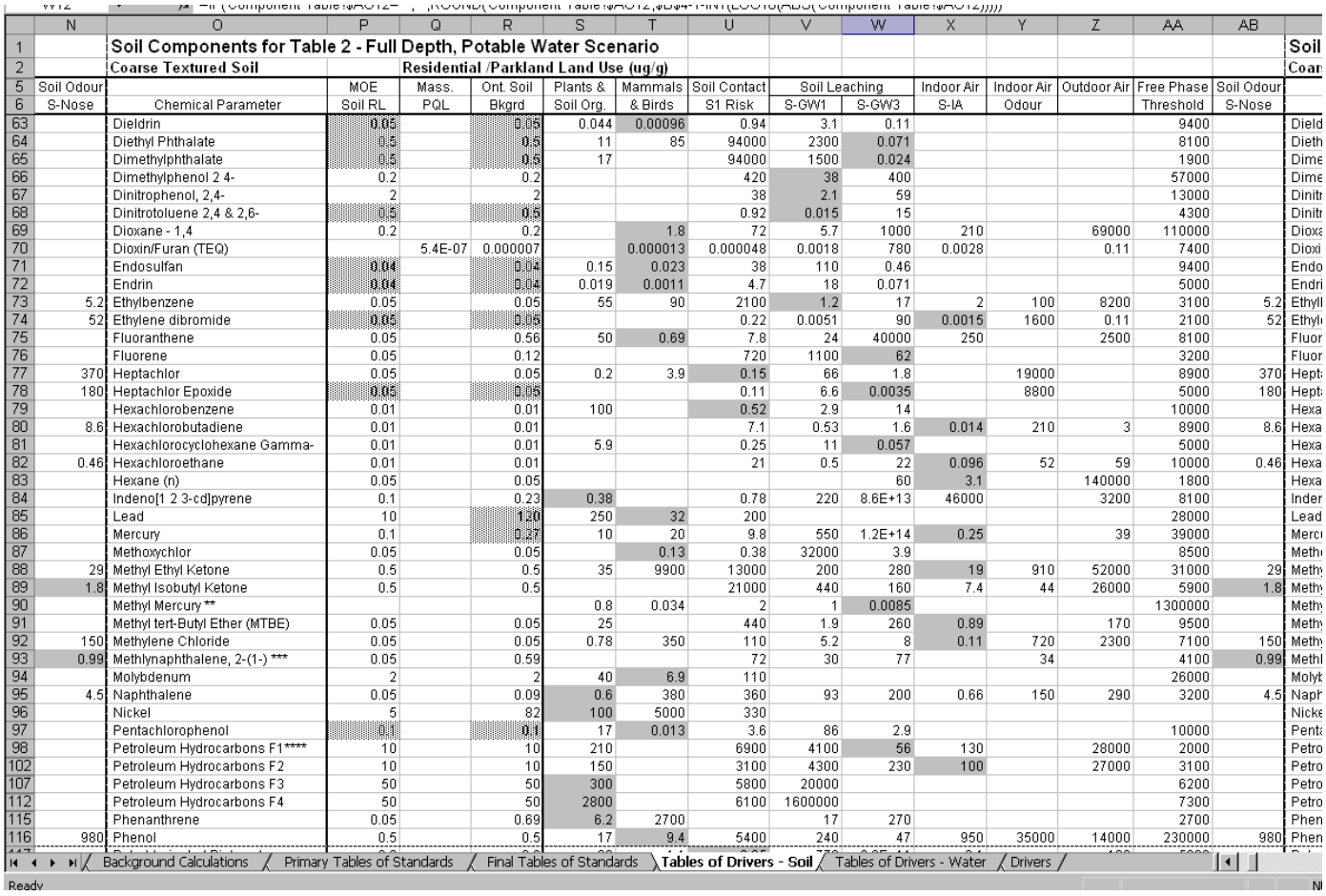
    If there are site properties described in cells A12 –A26 of the Tier 2 Input tab for which no measurements have been conducted, you may wish to check **Appendix 5** to determine if you can benefit from measuring them and using them in the Tier 2 process. The possibility of producing a less stringent Tier 2 number exists if there is a check mark in Appendix 5 against the measured parameter for the particular driver that is driving your PSS. The following general guide may be of assistance for determining how the Tier 2 can proceed from this point.

No Possibility of Change in Tier 2
– S3, GW1, Solubility

Change from Measured Parameters (see Appendix 5)
- S-IA, S-Odour, S-GW1, S-GW3, S-OA, GW2, GW3, Free Phase Threshold
- Note that SVSL measurements could affect S-IA and GW2

Change from Modified Ecological Protection Pathway Modification, no CPU (step 11)
– Plants and Soil Invertebrates, Mammals and Birds.

Change from Risk Management, CPU (see steps 12 to 14)
– S-IA, S-IA (Odour), S1, S2, GW2, S-Odour, Plants and Soil Invertebrates, Mammals and Birds.



	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1		Soil Components for Table 2 - Full Depth, Potable Water Scenario													
2		Coarse Textured Soil		Residential /Parkland Land Use (ug/g)											
5	Soil Odour		MOE	Mass.	Ont. Soil	Plants &	Mammals	Soil Contact	Soil Leaching		Indoor Air	Indoor Air	Outdoor Air	Free Phase	Soil Odour
6	S-Nose	Chemical Parameter	Soil RL	PQL	Bkgrd	Soil Org.	& Birds	S1 Risk	S-GW1	S-GW3	S-IA	Odour		Threshold	S-Nose
63		Dieldrin	0.05		0.05	0.044	0.00096	0.94	3.1	0.11				9400	
64		Diethyl Phthalate	0.5		0.5	11	85	94000	2300	0.071				8100	
65		Dimethylphthalate	0.5		0.5	17		94000	1500	0.024				1900	
66		Dimethylphenol 2 4-	0.2		0.2			420	38	400				57000	
67		Dinitrophenol, 2,4-	2		2			38	2.1	59				13000	
68		Dinitrotoluene 2,4 & 2,6-	0.5		0.5			0.92	0.015	15				4300	
69		Dioxane - 1,4	0.2		0.2		1.8	72	5.7	1000	210		69000	110000	
70		Dioxin/Furan (TEQ)		5.4E-07	0.000007		0.000013	0.000048	0.0018	780	0.0028		0.11	7400	
71		Endosulfan	0.04		0.04	0.15	0.023	38	110	0.46				9400	
72		Endrin	0.04		0.04	0.019	0.0011	4.7	18	0.071				5000	
73	5.2	Ethylbenzene	0.05		0.05	55	90	2100	1.2	17	2	100	8200	3100	5.2
74	52	Ethylene dibromide	0.05		0.05			0.22	0.0051	90	0.0015	1600	0.11	2100	52
75		Fluoranthene	0.05		0.56	50	0.69	7.8	24	40000	250		2500	8100	
76		Fluorene	0.05		0.12			720	1100	62				3200	
77	370	Heptachlor	0.05		0.05	0.2	3.9	0.15	66	1.8		19000		8900	370
78	180	Heptachlor Epoxide	0.05		0.05			0.11	6.6	0.0035		8800		5000	180
79		Hexachlorobenzene	0.01		0.01	100		0.52	2.9	14				10000	
80	8.6	Hexachlorobutadiene	0.01		0.01			7.1	0.53	1.6	0.014	210	3	8900	8.6
81		Hexachlorocyclohexane Gamma-	0.01		0.01	5.9		0.25	11	0.057				5000	
82	0.46	Hexachloroethane	0.01		0.01			21	0.5	22	0.096	52	59	10000	0.46
83		Hexane (n)	0.05		0.05					60	3.1		140000	1800	
84		Indeno[1 2 3-cd]pyrene	0.1		0.23	0.38		0.78	220	8.6E+13	46000		3200	8100	
85		Lead	10		1.20	250	32	200						28000	
86		Mercury	0.1		0.27	10	20	9.8	550	1.2E+14	0.25		39	39000	
87		Methoxychlor	0.05		0.05		0.13	0.38	32000	3.9				8500	
88	29	Methyl Ethyl Ketone	0.5		0.5	35	9900	13000	200	280	19	910	52000	31000	29
89	1.8	Methyl Isobutyl Ketone	0.5		0.5			21000	440	160	7.4	44	26000	5900	1.8
90		Methyl Mercury **				0.8	0.034	2	1	0.0085				1300000	
91		Methyl tert-Butyl Ether (MTBE)	0.05		0.05	25		440	1.9	260	0.89		170	9500	
92	150	Methylene Chloride	0.05		0.05	0.78	350	110	5.2	8	0.11	720	2300	7100	150
93	0.99	Methlynaphthalene, 2-(1-) ***	0.05		0.59			72	30	77		34		4100	0.99
94		Molybdenum	2		2	40	6.9	110						26000	
95	4.5	Naphthalene	0.05		0.09	0.6	380	360	93	200	0.66	150	290	3200	4.5
96		Nickel	5		82	100	5000	330							
97		Pentachlorophenol	0.1		0.1	17	0.013	3.6	86	2.9				10000	
98		Petroleum Hydrocarbons F1****	10		10	210		6900	4100	56	130		28000	2000	
102		Petroleum Hydrocarbons F2	10		10	150		3100	4300	230	100		27000	3100	
107		Petroleum Hydrocarbons F3	50		50	300		5800	20000					6200	
112		Petroleum Hydrocarbons F4	50		50	2800		6100	1600000					7300	
115		Phenanthrene	0.05		0.69	6.2	2700		17	270				2700	
116	980	Phenol	0.5		0.5	17	9.4	5400	240	47	950	35000	14000	230000	980

Background Calculations | Primary Tables of Standards | Final Tables of Standards | **Tables of Drivers - Soil** | Tables of Drivers - Water | Drivers

Ready

11. If the driving component is “Mammals and Birds” or “Plants and Soil Organisms”, then you may wish to consider whether it would be appropriate for your site to use the “**Modified Ecological Protection**” (MEP) option (by picking “Y” from the pull-down menu in cell B30). This option will generate a higher number for the “plants and soil organisms” component, and effectively eliminate the “Mammals and Birds” component. An acknowledgement that the option has been chosen must be placed on the RSC. For a full description of this option, read **Appendix 6** of this document.

12. To this point, none of the options chosen would result in a Certificate of Property Use (CPU), so if your property meets the Tier 2 PSSs at this stage, then a RSC could be filed without a CPU. However, all further Tier 2 options available from the next step on would typically be associated with a CPU.

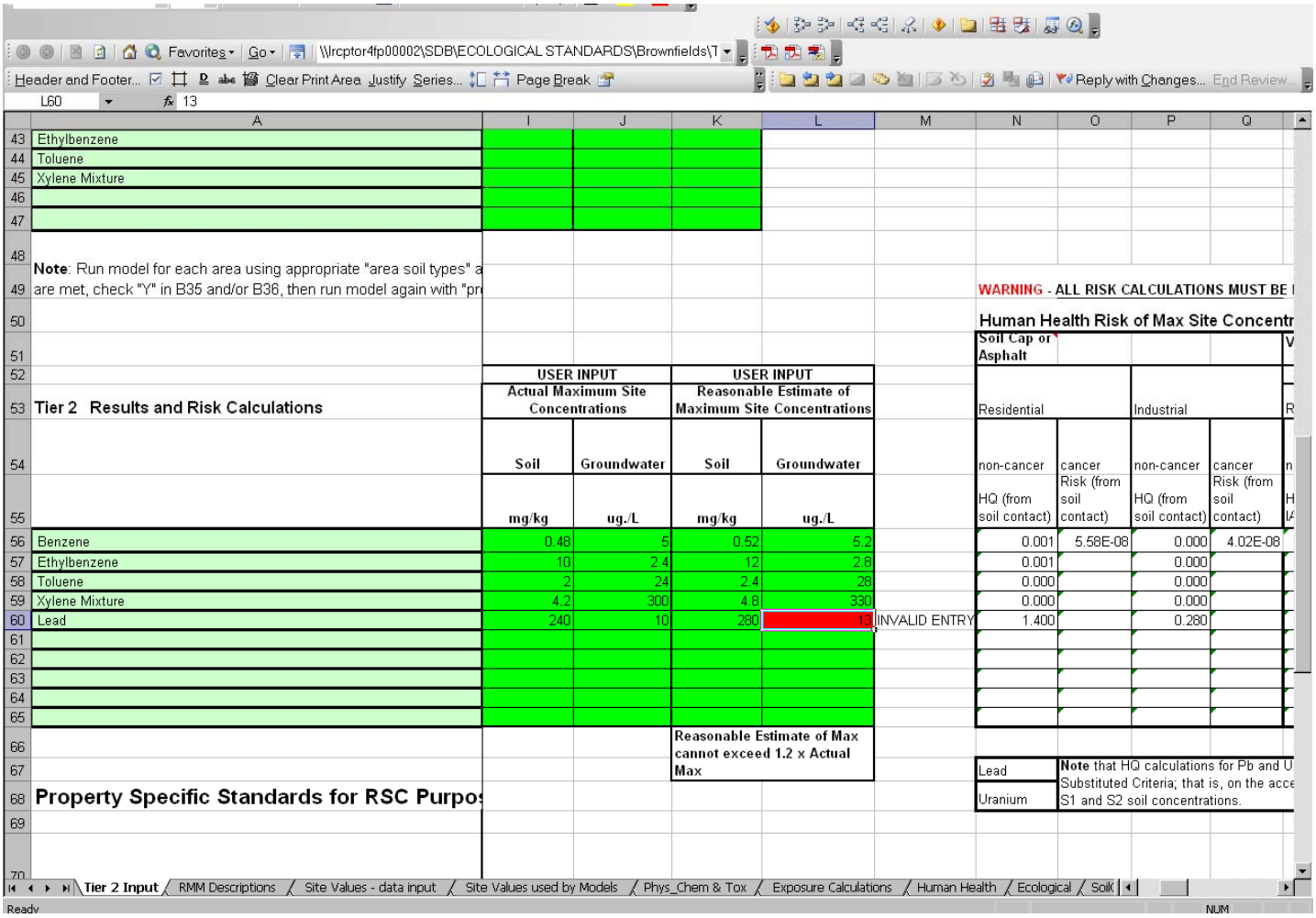
13. If your site soil still doesn't meet the Tier 2 standards and the driving component is any of "Mammals and Birds", "Plants and Soil Organisms", S1, or S2, then you may wish to consider the use of either a "Shallow Soil Cap" or a "Fill Cap" or "Hard Cap". These Risk Management Measures (RMMs) are described on the "RMM Descriptions" tab of the model workbook. In the "Tier 2 Input" spreadsheet, clicking on one of the RMMs hyperlinked in blue (A31-A34) will take you to the appropriate description. Choose the option appropriate for your site by picking "Y" on the pull down menu in Cells B31 or B32 of the Tier 2 Input spreadsheet.

14. If your measured concentrations still exceed the Tier 2 PSS, and the driver is either S-IA or GW2, then you may wish to consider having a building with "Ground Level Non-residential" (choose "Y" in cell B34) or a "Storage Garage" (i.e. ventilated parking garage) or having "No Enclosed Buildings" (choose cell B33 for either)

15. Here are restrictions on how Risk Management Measures (RMMs), Modified Ecological Protection (MEP) and Soil Vapour Screening Levels (SVSLs) can be combined:
    - MEP and SVSLs can be combined with anything
    - "Fill Cap" & "Hard Cap" can be combined with one another
    - "Shallow Soil Cap" cannot be combined with either of the other caps
    - "Shallow Soil Cap" can only be used if land use is industrial/commercial/community
    - "No Enclosed Buildings" cannot be combined with buildings containing a "Storage Garage" or "Ground Floor Non Residential"
    - Buildings containing a "Storage Garage" or "Ground Floor Non Residential" should not be combined with one another in the model (the "Storage Garage" is always more protective; adding "Ground Floor Non Residential" would give no additional relief; it is fine to have both at the actual site)
    - The "Ground Floor Non Residential" option should not be used if land use is industrial/ commercial/community (as it only provides relief for the residential/parkland/institutional land use)
    - Buildings containing a "Storage Garage" or "Ground Floor Non Residential" can be combined with caps; (however you would never use the Shallow Soil Cap (industrial) with the "Ground Floor Non Residential" (residential/parkland /institutional land use), as the shallow cap cannot be used on a residential site, and one would only use the "Ground Floor Non-Residential" on a residential site)

16. At this point, if you still don't meet all the Tier 2 PSSs generated by the above choices in the spreadsheet, you can proceed to conducting a full (Tier 3) RA and use the numbers generated above to reduce the amount of work required (e.g. reducing the number of chemicals or area of contamination) for a Tier 3 risk assessment, or remediate the contaminated areas that don't meet the PSSs developed above. If you do meet the PSSs after choosing any of the RMMs (A31–A34)), then you may submit the risk assessment to the Ministry for approval using those PSSs (Cells B72-D81).

17. When an RMM has been used, it is necessary to report what the risk level would be if the RMM were to fail. These risk levels are calculated in the Tier 2 spreadsheet in cells I56-AV65. **Please note that they must be calculated with all the RMMs in cells B30 to B34 turned off** (set at N). Cells B35 and B36 can be set to Y for the risk calculations only if all the Soil Vapour Screening Criteria were met for all soil vapour samples. The screenshot below shows the user input area (note the invalid entry where a reasonable estimate of the site maximum entered is higher than 1.2 times the actual measured value) and the first part of the risk calculations. Determine the risk level by looking under the appropriate risk management measure in Row s 51. The cancer risk level is given for carcinogens and the Hazard Quotient from each particular exposure component (e.g. soil contact) for non-carcinogens.

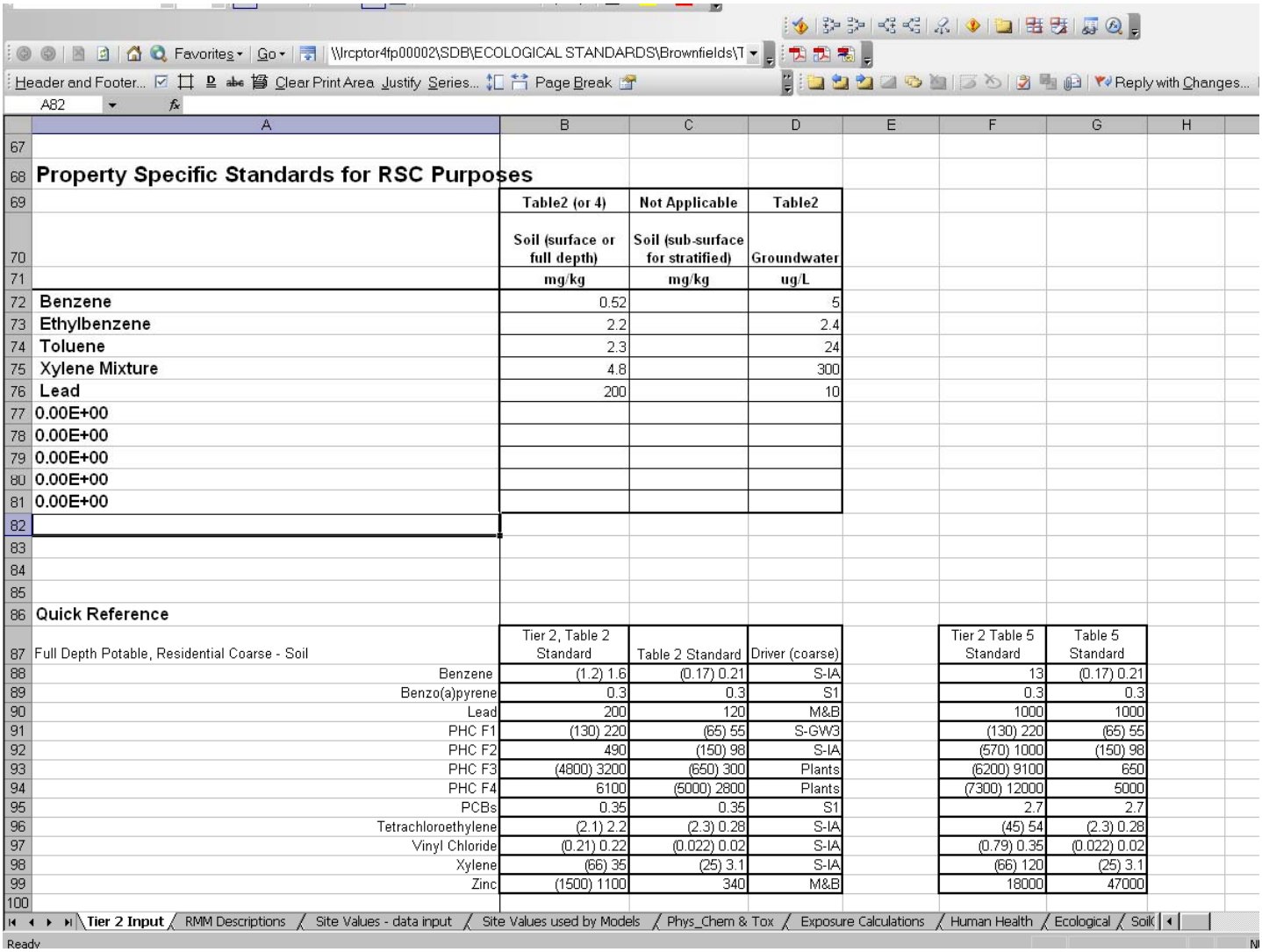


	A	I	J	K	L	M	N	O	P	Q
43	Ethylbenzene									
44	Toluene									
45	Xylene Mixture									
46										
47										
48										
49	**Note**: Run model for each area using appropriate "area soil types" a						WARNING - ALL RISK CALCULATIONS MUST BE			
50	are met, check "Y" in B35 and/or B36, then run model again with "pr						Human Health Risk of Max Site Concentr			
51							Soil Cap or Asphalt			V
52		USER INPUT		USER INPUT						
53	**Tier 2 Results and Risk Calculations**	Actual Maximum Site Concentrations		Reasonable Estimate of Maximum Site Concentrations			Residential		Industrial	R
54		Soil	Groundwater	Soil	Groundwater		non-cancer	cancer	non-cancer	cancer
55		mg/kg	ug./L	mg/kg	ug./L		HQ (from soil contact)	Risk (from soil contact)	HQ (from soil contact)	Risk (from soil contact)
56	Benzene	0.48	5	0.52	5.2		0.001	5.58E-08	0.000	4.02E-08
57	Ethylbenzene	10	2.4	12	2.8		0.001		0.000	
58	Toluene	2	24	2.4	28		0.000		0.000	
59	Xylene Mixture	4.2	300	4.8	330		0.000		0.000	
60	Lead	240	10	280	13	INVALID ENTRY	1.400		0.280	
61										
62										
63										
64										
65										
66				Reasonable Estimate of Max cannot exceed 1.2 x Actual Max						
67							Lead	Note that HQ calculations for Pb and U		
68	**Property Specific Standards for RSC Purpos**						Uranium	Substituted Criteria; that is, on the acce S1 and S2 soil concentrations.		
69										
70										

Tier 2 Input | RMM Descriptions | Site Values - data input | Site Values used by Models | Phys_Chem & Tox | Exposure Calculations | Human Health | Ecological | Soil(

Ready NUM

The next screenshot shows the area of the Tier 2 Input spreadsheet that displays the final Tier 2 PSSs. There is also an area (cells B86-B99) that gives a quick reference comparison for some common contaminants such that you can quickly see the effects of your Tier 2 changes in comparison to the Generic Table 2 Residential coarse soil standards.



	A	B	C	D	E	F	G	H
67								
68	**Property Specific Standards for RSC Purposes**							
69		Table2 (or 4)	Not Applicable	Table2				
70		Soil (surface or full depth)	Soil (sub-surface for stratified)	Groundwater				
71		mg/kg	mg/kg	ug/L				
72	Benzene	0.52		5				
73	Ethylbenzene	2.2		2.4				
74	Toluene	2.3		24				
75	Xylene Mixture	4.8		300				
76	Lead	200		10				
77	0.00E+00							
78	0.00E+00							
79	0.00E+00							
80	0.00E+00							
81	0.00E+00							
82								
83								
84								
85								
86	Quick Reference							
87	Full Depth Potable, Residential Coarse - Soil	Tier 2, Table 2 Standard	Table 2 Standard	Driver (coarse)		Tier 2 Table 5 Standard	Table 5 Standard	
88	Benzene	(1.2) 1.6	(0.17) 0.21	S-IA		13	(0.17) 0.21	
89	Benzo(a)pyrene	0.3	0.3	S1		0.3	0.3	
90	Lead	200	120	M&B		1000	1000	
91	PHC F1	(130) 220	(65) 55	S-GW3		(130) 220	(65) 55	
92	PHC F2	490	(150) 98	S-IA		(570) 1000	(150) 98	
93	PHC F3	(4800) 3200	(650) 300	Plants		(6200) 9100	650	
94	PHC F4	6100	(5000) 2800	Plants		(7300) 12000	5000	
95	PCBs	0.35	0.35	S1		2.7	2.7	
96	Tetrachloroethylene	(2.1) 2.2	(2.3) 0.28	S-IA		(45) 54	(2.3) 0.28	
97	Vinyl Chloride	(0.21) 0.22	(0.022) 0.02	S-IA		(0.79) 0.35	(0.022) 0.02	
98	Xylene	(66) 35	(25) 3.1	S-IA		(66) 120	(25) 3.1	
99	Zinc	(1500) 1100	340	M&B		18000	47000	
100								

18. For guidance on how to utilize the Tier 2 PSSs that you have just developed in the interim period before the new Generic Site Condition Standards (SCSs) and other regulatory amendments come into force, please refer to the Technical Update titled "**Interim Use of the Modified Generic Risk Assessment (MGRA) Spreadsheet Model in Risk Assessments Submitted Under the Record of Site Condition Regulation (O. Reg. 153/04)"**. This Technical Update can be found at: http://www.ene.gov.on.ca/envision/land/decomm/condition.htm

Limitations of the Tier 2 Spreadsheet Model

There are some standards for which no Tier 2 adjustments or RMMs will alter the SCS. For example, any potable GW SCS that is driven by drinking water is not changeable under Tier 2. Similarly, any soil SCS that is driven by an S3 (subsurface worker human health direct exposure) is also not changeable under Tier 2.

Any of the conditions for which the generic assumptions may not hold would result in a violation of the assumptions behind the Tier 2 model as well. These are repeated from the introduction to the generic standards as follows:

Conditions can exist at a site for which the assumptions used to develop the generic criteria may not be valid. The QP must ascertain that the site conditions are appropriate for use of the generic standards such that he/she can be comfortable with signing the certifications on the RSC. To assist the QP in recognizing the types of conditions that may be important in this respect the following examples are given:

a) if the contaminated zone has a volume larger than 340m3 or a source length or width greater than 13 metres then all pathways which employ source depletion or groundwater transport (Soil to Nose, S-GW1, S-IA, S-GW3, GW2 and GW3 components of the standards) may be affected.

b) if a high permeability zone is present in the vadose zone which provides a direct preferential pathway to the building then the soil properties assumed in the generic J&E modelling to determine the S-IA and GW2 components of the standard may change.

c) if the annual average of the capillary fringe of the water table is < 0.8 metres from the outer edge of the gravel crush of the building foundation, then the 10 x biodegradation factor assumed in the GW2 pathway for some VOCs may be non-conservative.

d) if the average Organic Carbon content (foc) of soil above the water table is < 0.002 then more contaminant may be in the water and gas phases than assumed in the generic standards.

f) if there is a continuous source of the contaminant then the pathways which assume a depleting source (i.e., S-IA, S-GW1, and Soil to Nose) might be non-conservative.

g) if there is a surface water body that could be affected by the property from contaminant migration via groundwater, and the surface water has total hardness less than 70 mg/L (as $CaCO_3$) and/or has pH less than 6.7, the aquatic protection values for some metals and pentachlorophenol may be non-conservative. In such cases, the QP may need to consider whether a site-specific estimate of hardness and pH resulting from mixing of groundwater and surface water is needed to estimate an appropriate aquatic protection value for this site.

The existence of any of the above conditions does not necessarily indicate that the Tier 2 PSSs are not valid for a given site. There are many interrelated parameters and factors that were used in the development of the generic standards, and in many cases one factor, such as any of those above, can be outweighed by differences in other factors in a manner that, overall, there is sufficient natural protection provided by the site. In addition, it must also be considered that the component that drives the standard may not be affected by the particular limiting condition described above (e.g. a terrestrial ecological driver, but there are high permeable zones in the vadose zone). The QP should consider these types of factors in assessing the appropriateness of the use of the Tier 2 PSSs.

For more information on Tier 2, contact the Streamlined Risk Assessment Coordinator at Standards Development Branch of the Ontario Ministry of the Environment (E-mail: SDB-Tier2RAReview@ontario.ca; Phone 416-327-5519).

Appendix 1: Recommendations for Phase Two Environmental Site Assessment
(in addition to Schedule C Requirements)

Assumption Category	Objective	Minimum Requirements
1. Fraction of Organic Carbon (FOC) – Water Table to Soil Surface	(a) Determine the FOC in the area between the water table and the soil surface.	1) Soil samples from at least four continuous borehole cores but not necessarily undisturbed soil samples must be collected at the phase two property for the purpose of defining FOC.
		2) The sample must be taken from soil between the soil surface and the top of the water table.
		3) The four sample locations must be chosen so as to provide results for natural (non-anthropogenic) FOC at the property.
		4) The samples must be taken from soil of the same soil type present in an area where a contaminant is present at a concentration greater than the applicable site condition standard for the contaminant.
		5) A minimum of one composite soil sample for each sampling location is required for FOC determination.
		6) Each soil sample for FOC determination shall be analyzed in triplicate.
		7) The FOC for the phase two property shall be the mean of all the soil samples analyzed for FOC determination.
		8) At least one soil sample shall be taken at each of the four sampling locations and analyzed for the contaminants of concern.
2. Fraction of Organic Carbon (FOC) – in Upper 0.5 m	(a) Determine the FOC in the upper 0.5 m of soil immediately below soil surface.	1) Soil samples shall be collected, from at least four locations at the property, each of which is in the upper 0.5 m of soil below soil surface at the time of sampling.
		2) The sample locations must be chosen so as to provide results for natural (non-anthropogenic) FOC at the phase two property.
		3) The samples must be taken from soil of the same soil type present in an area where a contaminant is present at a concentration greater than the applicable site condition standard for the contaminant.
		4) A minimum of one composite soil sample for each sampling location is required for FOC determination.
		5) The FOC for the phase two property shall be the mean of all the soil samples analyzed for FOC determination.
		6) At least one soil sample shall be taken at each of the four sampling locations and analyzed for the contaminants of concern.
3. Minimum Distance From Areas Where Contaminants Present Above Applicable Site Condition Standards to Nearest Down Gradient Water Body	(a) Determine the minimum distance from the centre of areas on, in or under the phase two property at which a contaminant is present at a concentration greater than the applicable site condition standard for the contaminant to the nearest water body that is down gradient of the area.	1) Using hydrogeological expertise and all relevant information from the phase two environmental site assessment, determine the distance from the centre of each area on, in or under the phase two property at which a contaminant is present at a concentration greater than the applicable site condition standard for the contaminant to the nearest water body that is down gradient of the area.
		2) Determine the shortest of these distances.
4. Minimum Depth Below Soil Surface to the Highest Annual Water Table	(a) Determine the minimum depth below soil surface to the highest water table in areas where volatile contaminants are present at	1) Where at least two years of water table level monitoring done at intervals no less frequent than quarterly has been undertaken for the water table at or within 250 metres from the boundary of the phase two property, water table level monitoring

	concentrations greater than the applicable site condition standards in ground water.	shall be conducted monthly for three months in order to determine the minimum depth of the high water table below soil surface. Such monitoring shall be conducted during the three months at which the highest water table can reasonably be expected to be at its highest elevation ASL based on historical data.
		2) If the historical water level information referred to in paragraph 1 is not available then either,
		a. water table level monitoring shall be conducted monthly for 12 months in order to determine the minimum depth of the highest water table below soil surface, or
		b. water table level fluctuations reasonably to be anticipated at the phase two property shall be identified and documented by the qualified person, water table level monitoring shall be conducted once and the greater of the anticipated fluctuation as identified by the qualified person or one metre shall be subtracted from the measurement taken during the water table level monitoring in order to determine the minimum depth of the highest water table below soil surface.
5. Aquifer horizontal hydraulic conductivity	(a) Determine the horizontal hydraulic conductivity for each aquifer that carries contaminants of concern to a water body.	1) A representative horizontal hydraulic conductivity for each aquifer that carries contaminants of concern to a water body shall be determined, which shall be done as follows:
		i. Field testing shall be conducted within the coarsest geological material in the aquifer for the purpose of determining horizontal hydraulic conductivity for each aquifer that carries the contaminants of concern from the aquifer to a water body.
		ii. The hydraulic conductivity values from field testing shall be compared with published values associated with the geological material which was tested.
		iii. If the field testing values are not consistent with published values associated with the geological material in the aquifer which was tested, or if there are any other reasons to believe the field testing quality is subject to uncertainty, an appropriately conservative multiplier shall be applied to the field testing values.
6. Aquifer Horizontal Hydraulic Gradient	(a) Determine the average horizontal hydraulic gradient across the phase two property to the nearest down gradient water body.	1) The average horizontal hydraulic gradient between aquifers on, in or under the phase two property and the nearest water body to which ground water at the property discharges shall be determined, which determination shall be done as follows:
		i. Water level measurements shall be taken from at least three monitoring wells at the property from the same hydrostratigrapic unit during at least one monitoring event.
		ii. The monitoring wells must not be placed in a straight line.
		iii. In selecting the monitoring wells from which to collect water level information and determining when to collect it the qualified person shall take into consideration fluctuations of ground water flow direction, so that water level measurements from these wells are representative of ground water flows from the aquifer to the nearest water body.
		2) For all aquifers where a contaminant of concern is

		present at a concentration greater than the applicable site condition standard for the contaminant, the qualified person shall ensure the following information is prepared:
		i. Contours of the interpreted ground water surface based on the water level measurements.
		ii. A determination of the approximate water level elevation of the nearest water body.
		iii. A calculation of the horizontal hydraulic gradient between the phase two property and the nearest water body. using the minimum distance from areas where a contaminant is present at a concentration greater than the applicable site condition standard for the contaminant to the nearest water body calculated as indicated above.
		3) Using the calculations referred to in subparagraph 2 iii, the qualified person shall ensure that the average horizontal hydraulic gradient between the phase two property and the nearest water body is calculated.
7. Aquifer Fraction of Organic Carbon (FOC)	(a) Determine the FOC in the aquifer that carries the contaminants of concern to a water body.	1) Samples of geological material in the aquifer that carries contaminants of concern to a water body must be collected from at least two sampling points.
		2) Each sample must be analyzed in triplicate.
		3) The FOC for the aquifer is the mean of all the samples.
8. Property Soil Type – Vadose Zone	(a) Determine the predominant soil type for the areas at the phase two property where a contaminant is present in soil or in ground water a concentrations greater than the applicable site condition standard for the contaminant.	1) In areas at the phase two property where a contaminant is present at concentrations greater than the applicable site condition standard for the contaminant, the predominant soil type in the vadose zone shall be determined as follows:
		i. For each area where a contaminant is present in soil only at a concentration greater than the applicable site condition standard for the contaminant, one or more boreholes must be advanced to the bottom of the area.
		ii. In any other case, one or more boreholes must be advanced to the top of the saturated zone.
		iii. The determination of the predominant soil type among all the areas shall be done through soil sampling and analysis as follows:
		a. an appropriate number and distribution of samples, but at least four samples, of soil from each area must be collected and analyzed in order to determine grain size distribution of the soil,
		b. grain size analysis shall be undertaken by an accredited laboratory,
		c. the predominant soil type from among all the areas must be determined based on analysis of the samples chosen in subparagraph a, and on borehole information, and
		d. where two or more soil types exist in approximately equal amounts, taking into account all the areas, the predominant soil type shall be the coarsest soil type from amongst those present in approximately equal amounts.
9. Property Soil Type – Capillary Fringe	(a) Determine the predominant soil type directly above the water table in the capillary fringe for the areas at the phase two property where a	1) In areas at the phase two property where a contaminant is present at concentrations greater than the applicable site condition standard for the contaminant, the predominant soil type in the capillary fringe shall be determined through soil

	contaminant is present in ground water in concentrations greater than the applicable site condition standard for the contaminant.	sampling and analysis as follows:
		i. One or more boreholes must be advanced to the top of the saturated zone.
		ii. The determination of the predominant soil type among all the areas shall be done as follows:
		a. an appropriate number and distribution of samples, but at least two samples, of soil from each area must be collected and analyzed in order to determine grain size distribution of the soil,
		b. samples must be taken from the stratum directly above the water table in the capillary fringe,
		c. grain size analysis shall be undertaken by an accredited laboratory,
		d. the predominant soil type from among all the areas must be determined based on the samples chosen in clause a, and on borehole information, and
		e. where two or more soil types exist in approximately equal amounts taking into account all the areas, the predominant soil type shall be the coarsest soil type from amongst those present in approximately equal amounts.
10. Area Soil Type - Vadose Zone	(a) Determine the coarsest soil type in the vadose zone in each area in which a volatile contaminant is present at a concentration greater than the applicable site condition standard for the contaminant.	1) In each area where a volatile contaminant is present in soil, or in ground water, at a concentration greater than the applicable site condition standard for the contaminant, determine the soil type in the area.
		2) For each area where a contaminant is present in soil only at a concentration greater than the applicable site condition standard for the contaminant, one or more boreholes must be advanced to the bottom of the area.
		3) In any other case, one or more boreholes must be advanced to the top of the saturated zone.
		4) The determination of the coarsest soil type for each area shall be done as follows:
		i. An appropriate number and distribution of samples, but at least four samples, of soil from each area must be collected and analyzed in order to determine grain size distribution of the soil.
		ii. Grain size analysis shall be undertaken by an accredited laboratory.
		iii. The coarsest soil type from among these samples for each are shall be identified.
11. Area Soil Type – Capillary Fringe	(a) Determine the coarsest soil type directly above the water table in the capillary fringe in each area of the phase two property where a volatile contaminant is present in ground water at a concentration greater than the applicable site condition standard for the contaminant.	1) In each area where a volatile contaminant is present at a concentration greater than the applicable site condition standard for the contaminant the coarsest soil type directly above the water table must be determined.
		2) One or more boreholes must be advanced to the top of the saturated zone.
		3) The determination of the coarsest soil type among all the area shall be done as follows:
		i. An appropriate number and distribution of

		samples, but at least two samples, of soil from each area must be collected and analyzed in order to determine grain size distribution of the soil.
		ii. Grain size analysis shall be undertaken by an accredited laboratory.
		iii. Samples must be taken from the stratum directly above the water table in the capillary fringe.
		iv. The coarsest soil type from among these samples for each area where a volatile contaminant is present in ground water at a concentration greater than the applicable site condition standard for the contaminant shall be identified.
12. Soil Vapour Concentrations and Depth to Soil Vapour Measurements	(a) Determine soil vapour concentrations in each area at the phase two property in which a volatile contaminant is present in soil, and in each area of the phase two property in which a volatile contaminant is present in ground water, at a concentration greater than the applicable site condition standard for the contaminant.	1) Soil vapour concentrations shall be determined in each area at the phase two property in which a volatile contaminant is present at a concentration greater than the applicable site condition standard for the contaminant, which determination shall be done as follows:
		i. The qualified person shall ensure a sampling and analysis plan for soil vapour characterization is prepared.
		ii. In this plan the qualified person shall determine the appropriate sampling locations for sampling soil vapour, including the appropriate depth for each location, which locations shall include the areas,
		a. where known or inferred releases of volatile contaminants have occurred,
		b. where the highest concentration of contaminants in soil and ground waters are present, and
		c. where the qualified person considers vapour intrusion related exposures may be of potential concern.
		iii. The soil vapour samples must be collected,
		a. from within the sampling location and at the depth that is approximately the same as the depth at which the highest concentration of the volatile contaminant in soil has been measured, and
		b. as close as possible to, but not more than 0.5 metres above the top of the capillary fringe in the area where the highest concentration of the volatile contaminant in ground water has been measured.
		iv. The soil vapour samples shall be collected and analyzed.
		v. The qualified person shall document the rationale for the selection of the soil vapour sampling locations and depths.
		vi. At least two soil vapour probes must be installed in each sampling location and depth. Multiple probes installed in a single borehole are not acceptable.
		vii. Samples shall be collected from the probes in each sampling location during at least two sampling events separated by at least three months.
		viii. Samples shall be collected from at least 1.5

		metres below the soil surface.
		ix. Screen intervals in soil vapour probes used for the sampling shall not exceed 0.5 metres.
		x. The depth to soil vapour measurement is the distance from soil surface to the top of the probe screening interval for each soil vapour probe from which samples are collected.
		2) The qualified person shall ensure that the soil vapour samples are collected using soil vapour probes that have been designed, constructed and operated within specifications for adequate measurement and in a manner that minimizes adsorption, desorption and leaks.
	(b) Where a site investigation is to include a soil vapour investigation, the following requirements apply, with necessary modifications	1) When soil vapour samples are to be analyzed for volatile contaminants, including volatile organic compounds, one trip blank sample shall be submitted for laboratory analysis with each laboratory submission;
		2) Sufficient field duplicate samples of soil vapour shall be collected so that at least one field duplicate sample can be submitted for laboratory analysis for every ten samples submitted for laboratory analysis;
		3) At least one field duplicate sample of soil vapour shall be submitted for laboratory analysis for every ten samples submitted for laboratory analysis; and
		4) Standard operating procedures shall be developed for soil vapour probe installation and soil vapour probe development, performance, leak testing and purging and sampling.

Appendix 2: Recommendations for Environmental Site Assessment (ESA) Reporting (in addition to Schedule C Requirements)

Report Section Heading	Sub-Heading	Recommended Content
A) Summary of Phase One and Two ESAs	1) Property Information	Provide:
		a) property location and ownership,
		b) municipal address and property identification number if any,
		c) size and boundaries of the property, and
		d) identification of the current and proposed uses of the property.
	2) Sampling Program	Provide:
		a) justification for the sampling program used in undertaking the phase two environmental site assessment;
		b) a summary of quality assurance and quality controls used for the sampling program and analysis of the samples;
		c) an assessment of whether the sampling program is sufficient for the purposes of the risk assessment and if not, a description of what further site investigations were conducted to support the risk assessment; and
		d) a rationale for and description of any hydrogeological and geological interpretations which differ from assumptions on which the Soil, Ground Water and Sediment Standards are based.
B) Modified Generic Risk Assessment	1) Number Frozen Days per year	Whenever an assumed value for Frozen Days is to be modified in a modified generic risk assessment, the report should include
		a) a reproduction of the of the "Number of Frozen Ground Days per Year" map used (Appendix 4), with the approximate site location shown, and
		b) the new value to be used in the MGRA.
	2) Fraction of Organic Carbon (FOC)	Whenever an assumed value for FOC (for the water table to soil surface, in the upper 0.5m, or the aquifer) is to be modified in a modified generic risk assessment, the report should include,
		a) a description of the rationale for determining sampling locations,
		b) a table with the sampling results,
		c) a figure showing the sampling points,
		d) finalized field logs, indicating the depth of the soil samples, and
		d) the new value to be used in the MGRA
	3) Distance to Water Body	Whenever an assumed value for distance to water body is to be modified in a modified generic risk assessment, the report should include a figure showing,
		a) the location of the property,
		b) areas where a contaminant is present at concentration greater than the applicable site condition standard for the contaminant,
		c) location of monitoring wells, ground water flow direction, interpreted flow pathways from each area to the nearest water body, estimated distance from each area to the nearest water body,
		d) nearest water body down gradient of each area noted in ii, and
		e) the new value to be used in the MGRA
	4) Depth to Water Table	Whenever an assumed value for depth to water table is to be modified in a modified generic risk assessment, the report should include,
		a) a description of, and rationale for, the method used to estimate the depth from soil surface to the highest water table,
		b) a figure showing the soil surface elevation contours, monitoring well locations, and measured depths to the highest water table from soil surface,
		c) a table with all the water level data used to determine the highest water table, and
		d) the new value to be used in the MGRA
	5) Aquifer Horizontal Hydraulic Gradient	Whenever an assumed value for aquifer horizontal hydraulic gradient is to be modified in a modified generic risk assessment, the report should include,
		a) a figure showing the location of monitoring wells, water level information, and ground water elevation contours,
		b) gradient calculations, and
		c) the new value to be used in the MGRA
	6) Aquifer Horizontal	Whenever an assumed value for aquifer horizontal hydraulic conductivity is to

	Hydraulic Conductivity	be modified in a modified generic risk assessment, the report should include,
		a) a description of field test methods, and interpretation of the field data,
		b) a rationale for the decision to use or not use a multiplier, and for the particular choice and use of any multiplier chosen and used in adjusting hydraulic conductivity values,
		c) all field data, calculations, and hydraulic conductivity values, and
		d) the new value to be used in the MGRA
	7) Aquifer Soil Dry Bulk Density	Whenever an assumed value for Aquifer Soil Dry Bulk Density is to be modified in a modified generic risk assessment, the report should include,
		a) a description of the geotechnical test method used to determine the aquifer soil dry bulk density along with the data used for the determination, the test results, and a site map showing the test points.
		b) a description of the method use to determine the aquifer soil dry bulk density applicable for the entire site (based on the test results), and
		c) the new value to be used in the MGRA.
	8) Soil Type in the Vadose Zone and Capillary Fringe	Whenever an assumed value for soil type in the vadose zone and capillary fringe is to be modified in a modified generic risk assessment, the report should include,
		a) for each area where a contaminant is present on, in or under the property at a concentration greater than the applicable site condition standard for the contaminant, the following information related to soil type in the vadose zone and capillary fringe, if applicable,
		i. a description of grain size analysis undertaken by an accredited laboratory. and the process and rationale for the selection of the soil type,
		ii. grain size distribution curves,
		iii. a figure showing all the sampling points, and
		iv. related finalized field logs, indicating the depth of the soil samples, and
		b) soil type selected as property soil type (for each of the vadose zone and capillary fringe), and the area soil type (in each of the vadose zone and capillary fringe) for each of the areas investigated.
	9) Soil Vapour Investigation - Depth to Soil Vapour Measurements	Whenever an assumed value for depth below soil surface to soil vapour is to be entered in a modified in a modified generic risk assessment, the report should include,
		a) a description of the rationale for the selection of the soil vapour sampling locations and depths,
		b) a discussion on soil vapour preferential pathways present or anticipated on the property, and whether and how they may affect vapour intrusion into existing and any known future buildings,
		c) a figure showing the locations of,
		i. existing and, if known, future buildings,
		ii. all soil vapour points,
		iii. areas where volatile contaminants are present at concentration greater than the applicable site condition standards,
		iv. known or inferred volatile contaminant release areas, and
		v. ground water flow direction,
		d) a minimum of one cross section for each area at which a contaminant is present at a concentration above the applicable site condition standards for the contaminant, which illustrates,
		i. variations in the soil surface elevation at the property,
		ii. soil and ground water sampling points,
		iii. soil vapour probe locations and depths,
		iv. interpreted distribution of the soil types present in the area,
		v. depth to water table, and
		vi. soil and ground water concentrations for the volatile contaminants referred to above, and
		e) a table summarizing the rationale for the location and depth of each soil vapour probe used in the soil vapour investigation, construction details of the probes including materials, diameter, length of the screen interval, and depth from soil surface to the top of the probe screening interval.
	10) Soil Vapour Investigations - Soil Vapour Concentrations	Whenever a value for soil vapour concentration is to be entered in a modified generic risk assessment, the report should include,

		a) a description of the soil vapour analytical methods, data quality objectives, rationale for the selected sampling method, devices and sampling duration,
		b) a description of the standard operating procedures for soil vapour probe installation and soil vapour probe development, performance testing, leak testing, purging and sampling used in the field investigation,
		c) a description of the quality assurance and quality control measures implemented,
		d) soil vapour field data, including leak test data, purge volumes and sample rates,
		e) soil vapour laboratory results presented in a tabular format by soil vapour sampling location and probe, including in the table depth to measurement (from soil surface to the top of the probe screening interval) and approved model calculated soil vapour screening level for each volatile contaminant,
		f) soil vapour probe finalized field logs including depths and installation details, and
		g) certificates of analysis or analytical reports for all soil vapour samples.
	11) References	Include a list of all documents or data cited in the report.

Appendix 3 Determination of Soil Type

Use the results of the soil texture analyses to determine which soil type is appropriate by placing the % sand and % silt (or clay) in the following triangle. . The point of intersection of the two lines gives the Soil Type. The triangle is from Figure 3-16 of the Soil Survey Manual, United States Department of Agriculture, Natural Resources Conservation Service, as published at its website. See
http://soils.usda.gov/technical/manual/print_version/chapter3.html for more information, or
http://soils.usda.gov/technical/aids/investigations/texture/ for an exact calculator.

FIGURE 3-16

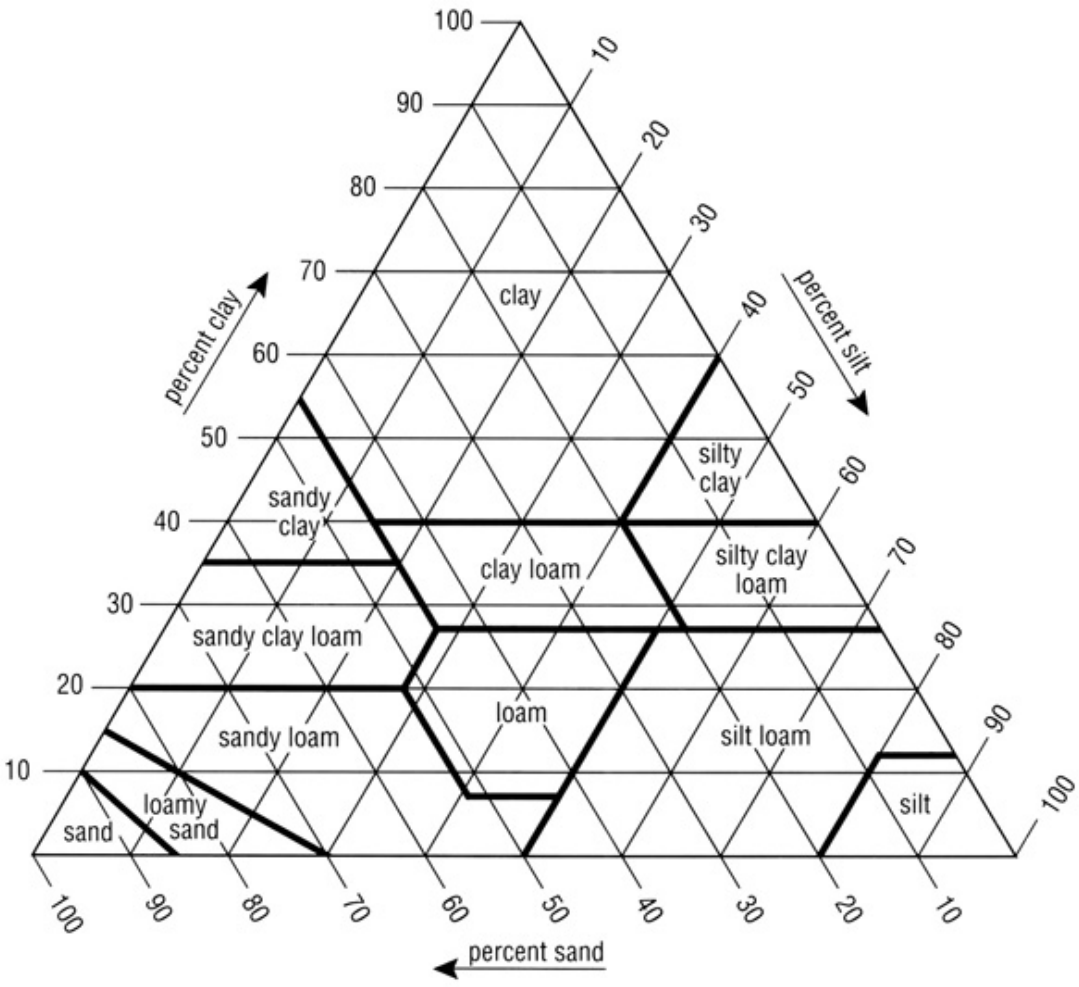


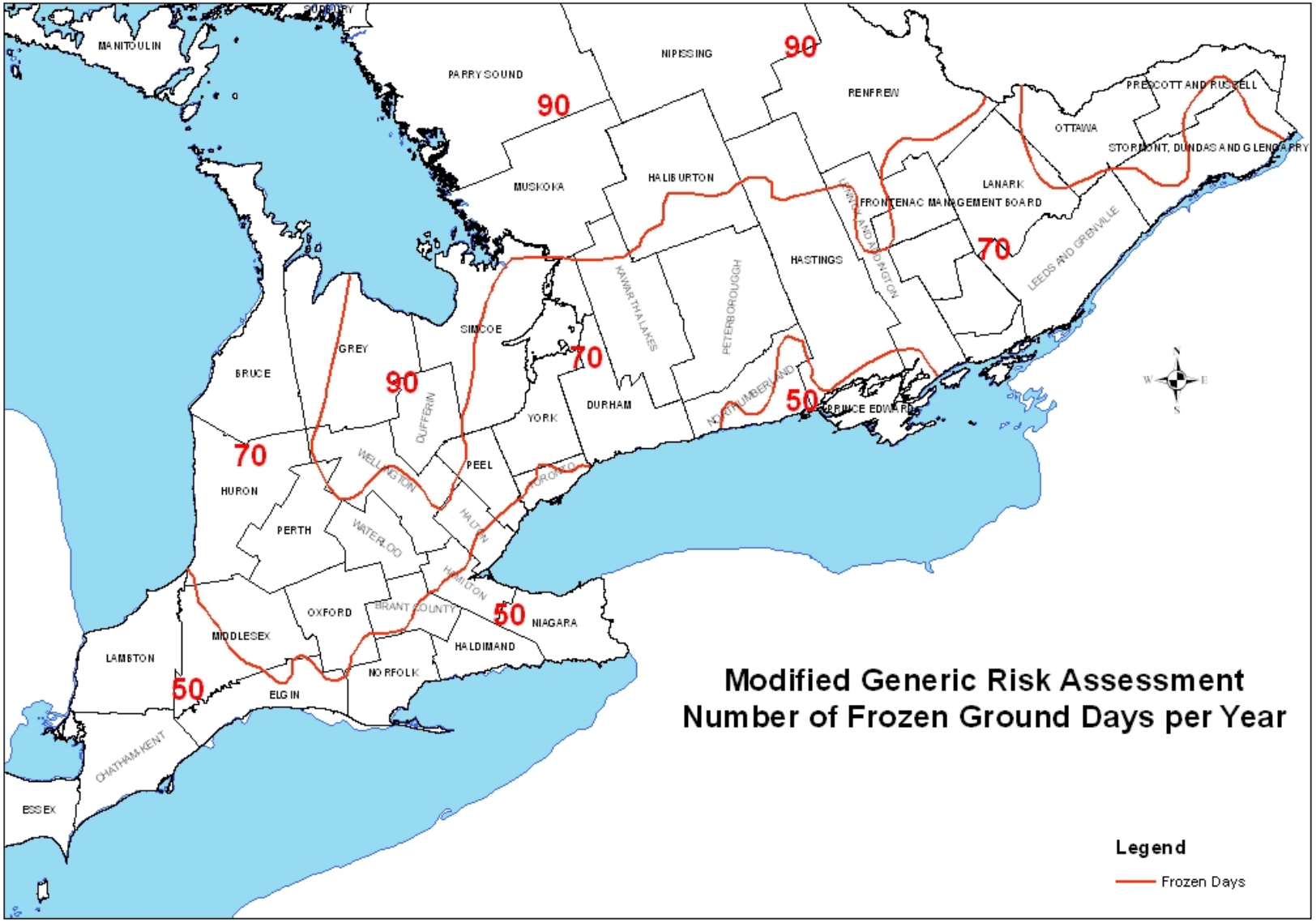
Chart showing the percentages of clay, silt, and sand in the basic textural classes.

USDA classification

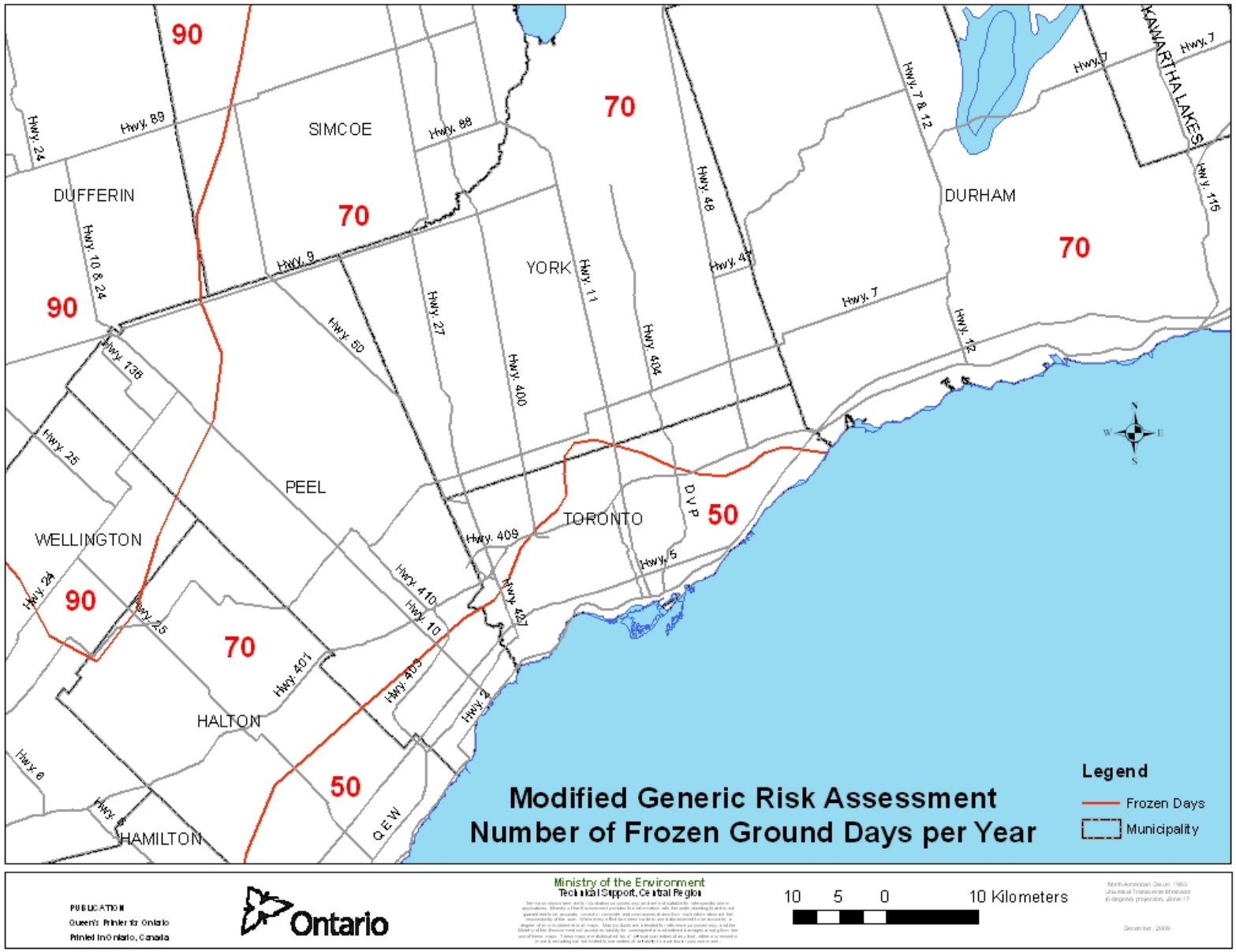
Sand - Soil particles between 0.05 and 2.0 mm in size
Silt - Soil particles between 0.002 mm and 0.05 mm
Clay - Soil particles smaller than 0.002 mm (2 microns) in size

Appendix 4 Maps Showing "Number of Frozen Ground Days Per Year"

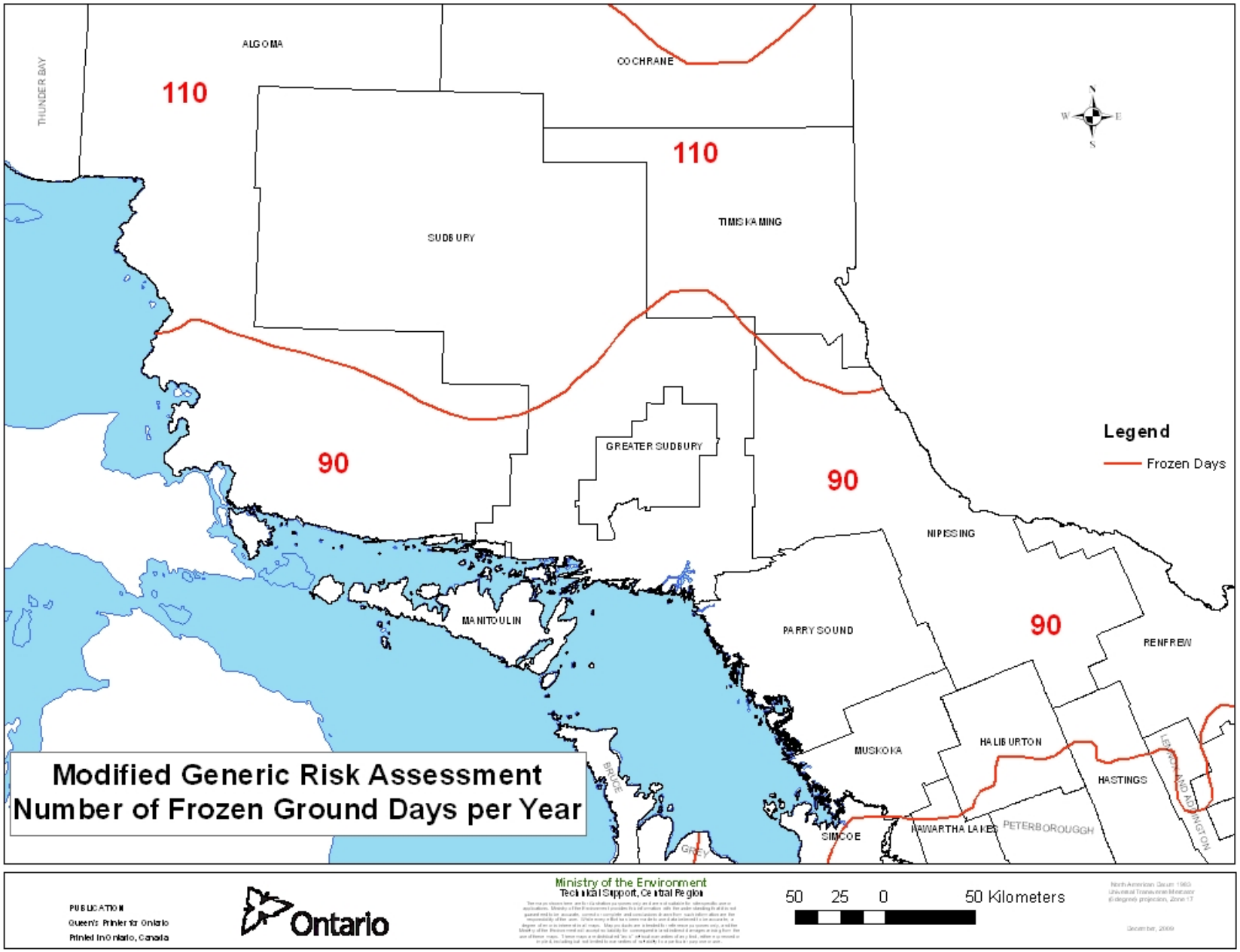
A1 – Southern Ontario



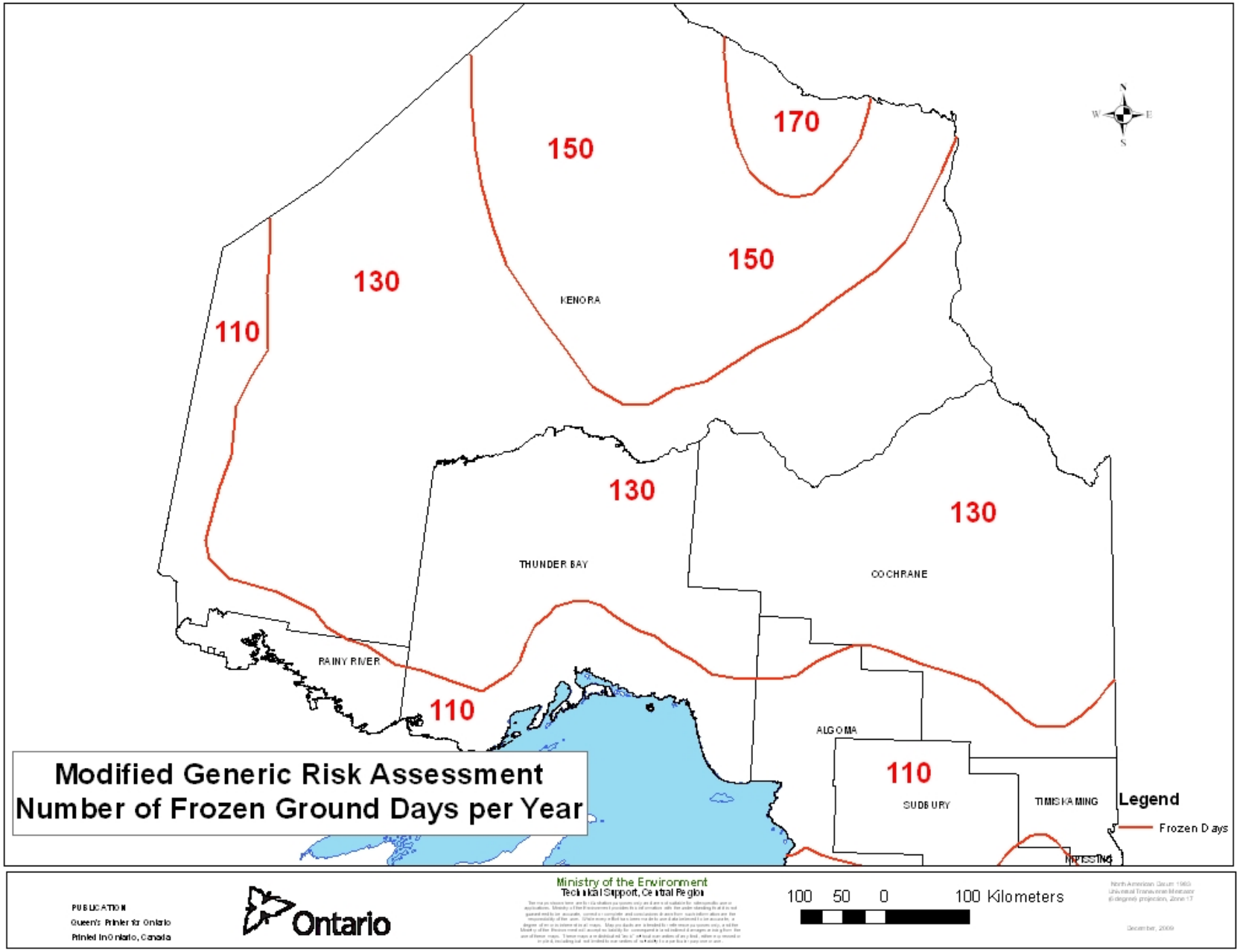
A2 – Greater Toronto Area



B – Central Ontario



C – Northern Ontario



Appendix 5: Chart to identify which Tier 2 input parameters affect which pathways (subsurface transport components)

Pathway\Tier2 Input Parameters	S-IA*	S- Odour	S-GW1	S-GW3	S-OA	GW1	GW2	GW3	Free Phase Threshold
Distance to surface water	NA	NA	NA	✓	NA	NA	NA	✓	NA
Soil FOC – water table to soil surface	✓	NA	✓	✓	✓	NA	NA	NA	✓
Soil FOC – upper 0.5m	NA	✓	NA	NA	NA	NA	NA	NA	NA
Depth to water table	NA	NA	NA	NA	NA	NA	✓	NA	NA
Property Soil Type – vadose zone	✓	✓	✓	✓	✓	NA	✓	NA	✓
Property Soil Type – capillary fringe	NA	NA	NA	NA	NA	NA	✓	NA	NA
# Frozen Days	NA	✓	NA	NA	NA	NA	NA	NA	NA
Aquifer horizontal hydraulic conductivity	NA	NA	NA	✓	NA	NA	NA	✓	NA
Aquifer horizontal hydraulic gradient	NA	NA	NA	✓	NA	NA	NA	✓	NA
Aquifer dry bulk density	NA	NA	NA	✓	NA	NA	NA	✓	NA
Aquifer FOC	NA	NA	NA	✓	NA	NA	NA	✓	NA

* Best method to do Tier 2 on S-IA pathway is using soil vapour screening methods as described in the body of this document.

NA = not applicable for pathway; ✓ = applicable for pathway

Descriptions of all Components

GW1 – Groundwater for drinking water purposes

GW2 – Groundwater for protection from movement to indoor air

GW3 – Groundwater for protection of aquatic life

S1 – Soil for protection of a residential receptor from direct contact with surface soil

S2 – Soil for protection from direct soil contact for a lower frequency and intensity exposure than residential surface soil, such as for commercial or industrial scenarios where children are not frequently present.

S3 – Soil for direct soil contact for a low-frequency, high-intensity, human health exposure scenario without children present that is protective of a worker digging in the soil.

S-IA –Soil for protection of movement to indoor air and human exposure.

S- OA – Soil for protection of movement to outdoor air and human exposure

S-Odour – Soil for protection from excessive odours

S-GW1 – Soil for protection from movement to groundwater for drinking water purposes

S-GW3 – Soil for protection from movement to groundwater and then to aquatic life

Plants and Soil Organisms – Soil for protection against adverse effects to plants and soil dwelling organisms

Mammals and Birds – Soil for protection against adverse effects through direct soil and food ingestion to mammals and birds

Appendix 6: Tier 2 Option: Modified Ecological Protection (MEP)

1) What is the Tier 2 modified ecological protection (MEP) option?

In order to allow the development and application of less stringent Property Specific Standards (PSS) at a contaminated site, current practice in Ontario is to remove ecological habitat to ensure no ecological species are present or exposed to contamination. This practice results in the removal of habitat which, although degraded, could and often does support a variety of ecological species. While redevelopment needs may drive the removal of habitat, the ministry's intent is to provide another option that will allow for greater preservation of ecological habitat. The ministry has developed a "modified ecological protection (MEP)" option within Tier 2 which is intended to both promote brownfield redevelopment and preserve existing and potential future ecological habitat. This means getting more brownfield properties developed and providing developers a greener alternative to paving over ecological habitat. The Ministry will continue to look at new ways of promoting ecological habitat preservation as part of brownfield redevelopment.

Modified ecological protection (MEP) is an option available to risk assessors within the modified generic risk assessment process (Tier 2) in Ontario that uses less stringent ecotoxicity values to develop Tier 2 property specific standards (PSS). The use of the MEP option will allow for the maintenance or establishment of natural habitat; habitat that is not comparable in quality to habitat in an uncontaminated setting but instead is habitat comprising of assemblages of species that are adapted or less sensitive to the contaminants of concern at the property. Use of the MEP option may result in adverse effects to some plants, soil organisms and wildlife that might reside in or frequent the site. The MEP option does provide the **same degree of protection to humans** as the Tier 1 generic standards.

Under the MEP option, ecotoxicity values for mammals and birds are removed from the modified generic model for both residential/parkland and commercial/industrial land uses. Therefore no protection is provided for those ecological receptors under the MEP option. For plants and soil invertebrates under both residential/parkland and commercial/industrial land uses, the Tier 2 MEP option utilizes a multiplier (1.9 x industrial component value) that is equivalent to the 75^{th} percentile value for each dose-response data set (developed for generic model values using the CCME protocol weight-of-evidence procedure where resulting No Observable Effect Concentration (NOEC) and Lowest Observed Effect Concentration (LOEC) data are ranked and ranked percentiles are determined for each data point).

2) What is the purpose of the MEP option?

The MOE recognizes that maintaining natural environments on remediated brownfield sites should be encouraged wherever possible. Soil standards at a brownfield site can often be driven by ecological risks to soil-dwelling invertebrates, plants and wildlife; therefore, "paving" a site as a means of removing potential ecological risks is one option that is exercised by property owners. However, paving a site provides no opportunity for any current or future natural habitat to exist on a property.

The MEP option in Tier 2 will provide the property owner with a viable alternative to risk management measures such as "paving". The MEP option will allow the property owner to use ecotoxicity values that will yield less stringent Property Specific Standards (PSS) values that can support a natural but relatively degraded environment; however it also may result in adverse effects to some plants and soil organisms. As a result, some species may not thrive as they would have at a site that is uncontaminated or which meets the more stringent generic site condition standards. However, more robust species will have the opportunity to populate this habitat which provides a more ecologically sustainable alternative to paving a site and promotes the redevelopment of Brownfield properties.

3) Degree of protection provided by the MEP option

It is important to note that unlike other Tier 2 options (i.e., the input of site-specific parameters into model inputs or the use of standardized risk management measures) use of the MEP option does *not* provide the same degree of ecological protection that is provided by the Tier 1 generic standards. Instead a lower degree of ecological protection is permitted under the MEP option and adverse effects to some portions of ecological receptor populations may be anticipated in many cases. However, the MEP option *does* provide the same degree of protection to humans as the Tier 1 generic standards.

The MOE acknowledges that at some sites the higher soil concentrations allowed under the MEP option might not cause adverse ecological impacts due to ameliorating site-specific conditions (e.g., decreased bioavailability due to soil physicochemical characteristics or due to the site-specific speciation of the contaminant(s), differential sensitivity of species at a site relative to those used to generate ecotoxicity values, plasticity or adaptation of the species at the site, etc.). Therefore, use of the MEP option may not result in adverse ecological impacts. Should a property owner need to demonstrate that no adverse ecological impacts have resulted from leaving concentrations of contaminants using the MEP option a Tier 3 risk assessment must be conducted.

Note on human health exposure pathway through ingestion of plants

The Tier 2 MEP option is available for all land uses except agriculture. The model under the Tier 2 MEP option incorporates all of the same assumptions and exposure pathways for soil contaminants for the protection of human health as the Tier 1 generic model. Therefore the MEP option provides the same degree of protection to humans as the Tier 1 generic standards. However, the Tier 1 model (and therefore the Tier 2 model) does not incorporate the soil-to-plant uptake-to-human ingestion pathway. This is because the current state of the science is very uncertain and excessive conservatism may be required in order to cover all uncertainties, especially with respect to modelling soil-to-plant uptake values in a scientifically defensible manner. There is an enormous amount of variability in the rate of bioaccumulation of individual contaminants in plants in the scientific literature. Uptake factors can vary by orders of magnitude among species and even within subspecies and varieties. Under the Tier 2 MEP option, soil concentrations at the 75^{th} percentile are not in a range anticipated to cause significant phytotoxicity. Therefore plants grown at these concentrations would likely survive and have the potential to be used as a food item (the same is true for plants grown in soil under generic Tier 1 conditions). Because there is a potential that plants that might be ingested by humans accumulate higher concentrations of contaminants under the Tier 2 MEP option compared to plants grown in soil with contaminant concentrations at the Tier 1 generic

standards, the Tier 2 MEP option is not permitted under agricultural land uses. It is also not permitted for agricultural land uses because decreased protection of plant life is incompatible with agricultural land use. The exclusion of the soil-to-plant uptake-to-human ingestion exposure pathway in the generic model is an acknowledged gap and will be re-evaluated at a future date once the scientific data supporting the development of this pathway into the generic model becomes available.

4) How is the MEP option used within Tier 2?

MEP is an option available to the QP_{RA} in a similar fashion as the Tier 2 adjustable input parameters and risk management measures options. If a QP_{RA} wishes to invoke the MEP option for a site, they simply select the "Modified Ecological Protection" option in the Tier 2 spreadsheet model or web-based interface. The Tier 2 model then recalculates the PSS based on the modified ecological values under the MEP (as well as any other changes in the model if other Tier 2 adjustable parameters have been modified by the QP_{RA}).

5) How is the MEP option reported?

Any RSC that utilizes standards that were developed with the MEP option will state such on the RSC itself and will be posted on the Brownfields Environmental Registry for public viewing at any time.